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increased in size and became soft, slender, conical protuberances of bluish color, and about five eighths of an inch in length. These became the framework of a growth of a moss-like gill structure, that covered them completely. When these changes were complete, the "water-dog" had assumed the form familiar to the writer, and known to be the axolotl. This animal he had regarded as distinct from the "water-dog," and the apparent identity of the two animals impressed him greatly. Later he secured a publication concerning this, to him, amazing transformation; but the transformation therein described was of the reverse order, or from the axolotl form to that of the "water-dog." As the writer shortly after removed to the east, he had no opportunity of repeating the experiment, and finally dismissed the matter from his mind. If the facts here detailed have not been hitherto recorded, it would be interesting if some one would repeat this experiment, which is a too distant memory to be submitted as a scientific demonstration.

R. D. O. JOHNSON

NOTE ON THE LIFE HISTORIES OF THE FERN RUSTS
OF THE GENUS *UREDINOPSIS*

UNDER *Peridermium balsameum* Peck the writer¹ described experiments and observations which indicated that the fern rusts belonging to the genus *Uredinopsis* are heteroecious, having their æcial stage on *Abies balsamea* (L.) Mill. Artificial infection experiments carried on during the present season by the writer have established the conclusions there stated. These experiments have shown that *Uredinopsis Osmundæ* Magn., *U. Struthiopteridis* Störmer, *U. Phegopteridis* Arthur, *U. mirabilis* (Peck) Arthur, and *U. Atkinsonii* Magn. have their æcial stages on *Abies balsamea* (L.) Mill. The æcia are the white spored forms that have passed as *Peridermium balsameum* Peck. A detailed description of the experiments will be published soon.

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¹ *Mycol.*, 4: 189, 1912.

"PAWLOW"

I NOTE with interest Professor Halsted's protest¹ against the spelling of Lobachevski's name with a "w," a sort of scientific Wellerism which Teutonic influence has foisted upon the English language. Is it too much to hope that some day we may find American physiologists referring to Pavloff instead of to Pawlow, or is it true that in such mixed crosses, as the heredity experts would say, German pedantry is prepotent over common sense?

J. F. ABBOTT

SCIENTIFIC BOOKS

Non-Euclidean Geometry. A critical and historical study of its development. By ROBERTO BONOLA. Translated by H. S. CARSLAW. Chicago, The Open Court Publishing Co. 1912.

To Dr. Paul Carus the world is greatly indebted for making this book accessible in the universal language, English.

There are two ways of envisaging the coming of non-euclidean geometry; either as a gradual development or as a saltation. The first attitude is taken in my article, "The non-euclidean geometry inevitable";¹ the second in the introductions to my translations of Lobachevski and Bolyai, where I say Lobachevski was the first man ever to publish a non-euclidean geometry, though Bolyai's marvel of genius went perfect to the printer in the same year, 1829, the most extraordinary two dozen pages in the whole history of thought.

Bonola's book takes the developmental viewpoint, and the first 83 pages give a just and adequate account of the forerunners of non-euclidean geometry, with whom belong Schweikart, Gauss and Taurinus, though far greatest of whom was Saccheri.

The inadequacy of the book is in the 30 pages, out of 268, devoted to the real founders of non-euclidean geometry, John Bolyai and Lobachevski, whose very names Carslaw has

¹ *SCIENCE*, May 10, 1912, p. 736.

¹ *Monist*, 4, 483-493.

bungled. The name of the proud young Magyar, Bolyai János, Bonola correctly translates into Italian as Giovanni Bolyai, John Bolyai. Carslaw seems to think him an Austrian, and always calls him Johann (16 times or more). He might as well have called him Ivan. The young Hungarian had the racial hatred for Austrians. In garrison, 13 of them, cavalry officers, challenged him at once with the saber. He accepted, only stipulating that between each two duels he might play a piece on his violin. He was victor over all.

His father, Bolyai Farkas, could at need deal more tactfully with the common enemy. When an Austrian Schulrath was sent with hostile intent to inspect the protestant college at Maros-Vásárhely, a nest of Magyar rebels, old Bolyai Farkas received him with exceeding geniality, related with zest and fire the experiences of his student life in Germany, and took him to dinner. They ate, drank and talked like two German students. "The interests of the college required it, and they said 'Du' to one another." And that the Schulrath should see near him no rebel faces, Farkas bade his son sacrifice his beautiful beard. Bolyai won. The Austrian was kept away from the college.

Franz Schmidt told me in Budapest his father had seen Bolyai János in Temesvár in mere wantonness of the pride of life cut off with his beautiful Damascus blade an iron spike driven into his doorpost. And now Carslaw in English calls him Johann!

No better fares it with Lobachevski. Bonola gives his name in Italian as Nicola Ivanovic Lobacefski, in which the very same Russian letter B is twice transliterated v and then f. Carslaw makes the worse blunder of twice transliterating it v and then w. But another single Russian letter, equivalent to the Italian c, our ch as in church, Carslaw transliterates as four letters together, and so in translating the name, Carslaw gives it *seven* additional letters, and besides all that, a substitute letter w which wholly destroys the sound, since Carslaw's tschew can have in English only the sound made offensive by Fletcher.

The fault of the seriously unsatisfactory and misleading exposition of Lobachevski's transition work of 1826 is Bonola's. Bonola pretends to know all about the contents of this memoir, never printed and of which no manuscript has ever been found, while really oblivious to the never explained paradox of its very name: *Exposition succinete des principes de la géométrie, avec une démonstration rigoureuse du théorème des parallèles*. What a horribly unfortunate title for a man who three years later began to publish work which shows such "*démonstration rigoureuse*" eternally impossible! He never confesses what it was.

And again when he gradually became conscious of "the possibility of the existence of geometry in a wider sense than that in which Euclid first expounded it to us," that which young John Bolyai, with his magnificent nerve, in 1829 called "The Science Absolute of Space," Lobachevski in 1835 called "Imaginary Geometry." In 1855, going blind and dying, he gives it at last a more worthy name, Pangeometry, but dies without its having obtained the slightest public recognition and without having made a single disciple. Nothing could be more false than Carslaw's sentence, p. 86:

Non-Euclidean Geometry, just as it was conceived by Schweikart in 1816, became in 1829-30 a recognized part of the general scientific inheritance.

In fact for more than a third of a century thereafter, it was as if it had never been born.

A voluminous work by the academician Buniakovski appeared in St. Petersburg in 1853 in which Lobachevski is not even mentioned, and in all his published works Gauss never even once mentioned the name of Lobachevski or of John Bolyai. Yet the two dozen pages of John Bolyai was something incalculably tremendous. Is then the silence of Gauss to be attributed to meanness or blindness? He said he "feared the outcry of the Bæotians," if he should speak. Max Simon says, 1901,

Never believe that Gauss ever doubted the actual truth of the parallel assumption for our space.

Yet just now, 1912, this space of ours is being proved non-euclidean by the principle of relativity. Says Vladimir Varićak in a wonderful lecture, "Ueber die nichteuklidische Interpretation der Relativtheorie,"²

I postulated that the phenomena happened in a Lobachevski space, and reached by very simple geometric deduction the formulas of the relativity theory. Assuming noneuclidean terminology, the formulas of the relativity theory become not only essentially simplified, but capable of a geometric interpretation wholly analogous to the interpretation of the classic theory in the euclidean geometry. And this analogy often goes so far, that the very wording of the theorems of the classic theory may be left unchanged.

To see that this will prove our space Bolyaian, we have only to remember Poincaré's dictum:

These two propositions, the earth turns round, and, it is more convenient to suppose that the earth turns round, have one and the same meaning.³

The first man, to so bring forth the non-euclidean geometry that it was not stillborn, but lived and grew, was the Frenchman Hoüel, by his translations of Lobachevski in 1866 and John Bolyai in 1867. Thirty years later, in my translator's preface, I said:

No part of Lobachevski's largest work, "New Elements," has ever before been published in any language but the original Russian.

I gave an account of it in 1893 at the Mathematical Congress of the World's Columbian Exposition, and promised then the publication of my translation.⁴ This promise was delayed for a personal visit to Kazan, the home of Lobachevski, and Maros-Vásárhely, the home of Bolyai. Only through his little book "Geometrical Researches,"⁵ have Lobachevski's ideas been heretofore accessible to the world in general.

But it is preeminently in his "New Elements"

² *Jahresber. D. Math. Ver.*, 21, 103-127.

³ "The Value of Science," Halsted's translation, p. 140.

⁴ See "Mathematical Papers of Chicago Congress," pp. 92-95.

⁵ Hoüel, 1866; Halsted, 1891.

that the great Russian allows free expression to his profound philosophic insight, which on the one hand shatters forever Kant's doctrine of our absolute *a priori* knowledge of all fundamental spatial properties, while on the other hand emphasizing the essential relativity of space.

The realities which with the aid of the euclidean space form we understand under motion and position, may, with the coming of more accurate experience, refuse to fit in that form. Our mathematical reason may decide that they would be fitted better by a non-euclidean space form. Space is presupposed in all human notions of motion or position. We may drop out such specifications from our space form as render it specifically euclidean. Euclidean space is a creation of that part of mind which has worked and works yet unconsciously.

It is not the shape of the straight lines which makes the angle-sum of a rectilinear triangle two right angles.

With straight lines of precisely such shape but in a non-euclidean space, this sum may be greater or less. In non-euclidean spaces, if one edge of a flat ruler is a straight line the other edge is a curve, if the ruler be everywhere equally broad. In any sense in which it can be properly said that we live in space, it is probable that we really live in such a space.

And now fifteen years later comes the relativity theory to prove all this, and to make non-euclidean geometry a powerful machine for advance in physics.

GEORGE BRUCE HALSTED

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Allen's Commercial Organic Analysis. Volume V. Tannins, Dyes and Coloring Matters, Inks. Edited by W. A. DAVIS and SAMUEL S. SADTLER. P. Blakiston's Son and Co. Philadelphia, 1911. Price \$5.00.

This volume contains the following chapters: Tannins by W. P. Dreaper. Analysis of Leather by W. P. Dreaper. Dyes and Coloring Matters by W. P. Dreaper and E. Feilmann. Dyestuffs of Groups 6 to 12 by J. T. Hewitt. Coloring Matters of Natural Origin by W. M. Gardner. Analysis of Coloring Materials by W. P. Dreaper and E. Feilmann.